Background for the Shields-1 CubeSat Vault Electronics (VE) Request for Quote

List of Acronyms/Abbreviations

ADCS	Attitude Determination and Control System
API	Application Pogromming interface
ARO	After Receipt of Order
C&DH	Command and Data Handling
DAU	Data Acquisition Unit
EMI	Electro-Magnetic Interference
GTO	Geo Transfer Orbit
I^2C	Inter-Integrated Circuit
LET	Linear Energy Threshold
P-Pod	Poly-Picosatellite Orbital Deployer
RF	Radio Frequency
SEFI	Single Event Functional Interrupt
SEL	Single Event Latchup
SEU	Single Even Upset
SOW	Statement Of Work
TID	Total Ionizing Dose
U as in 3U, 2U, 1U	Unit
VE	Vault Electronics
WFF	Wallops Flight Facility

Background for the Shields-1 CubeSat Vault Electronics (VE) Request for Quote

Vault Electronics (VE) Specification

1. Shields-1 Mission/System Description

NASA Langley Research Center is preparing space environment research payloads for technology development, using CubeSats. Shields-1, the CubeSat mission, will test radiation shielding materials in the Van Allen radiation belts. The satellite (CubeSat) will be deployed into a geosynchronous transfer orbit (GTO) or other highly elliptical orbit (see Figure 1-1). The Shields-1 CubeSat will be in communication with a ground station equipped the 18m dish at Wallops Flight Facility (WFF) or equivalent. The Shields-1 CubeSat is a 2U Instrument, containing radiation shielding materials samples and instrumentation, that will be integrated with a 1U Vault to form the 3U CubeSat (see Satellite Segment in Figure 1-2). The Vault will provide a radiation shielding housing to protect the interior electronics. The VE obtained via this procurement will be used to provide the satellite operating functions for the Shields-1 CubeSat, including power collection, storage and management, command and data handling, and communications to and from the ground.

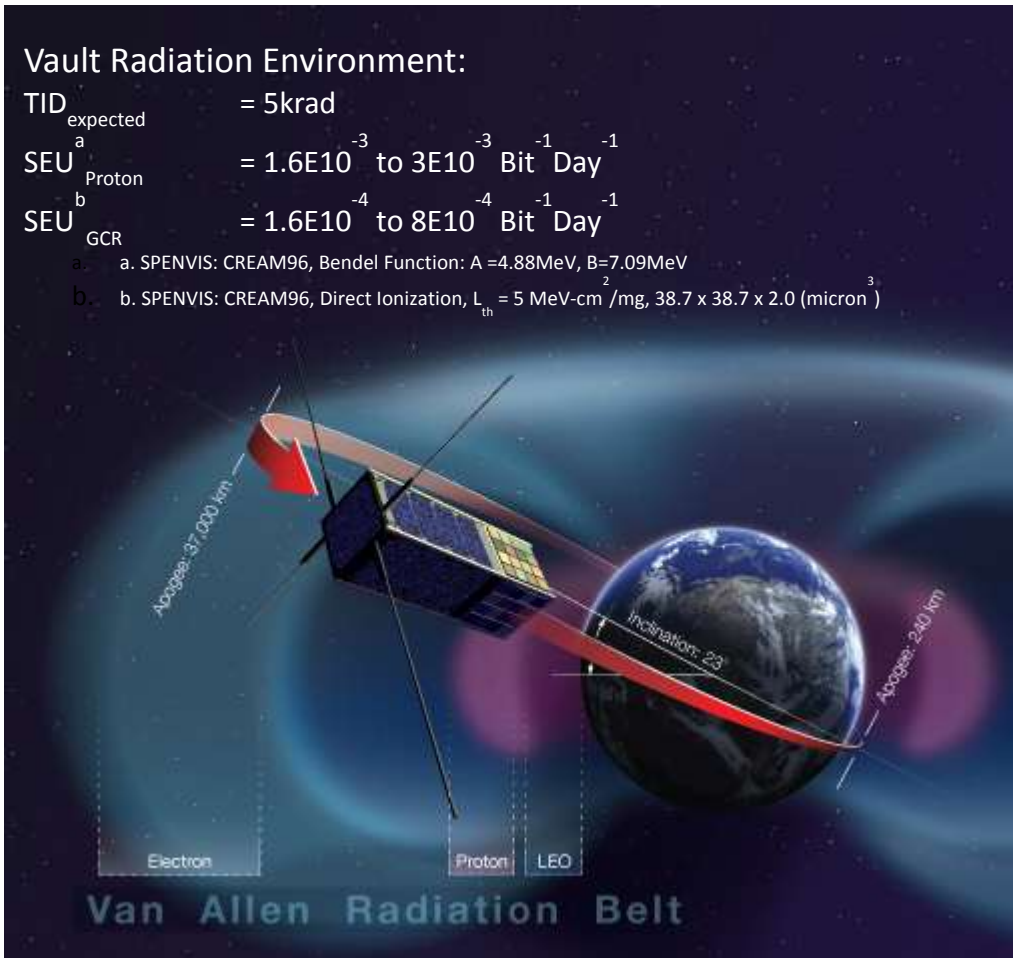

Figure 1-1: Shields-1 mission concept. A CubeSat containing radiation shielding material samples in a highly elliptical orbit exposed to radiation environment.

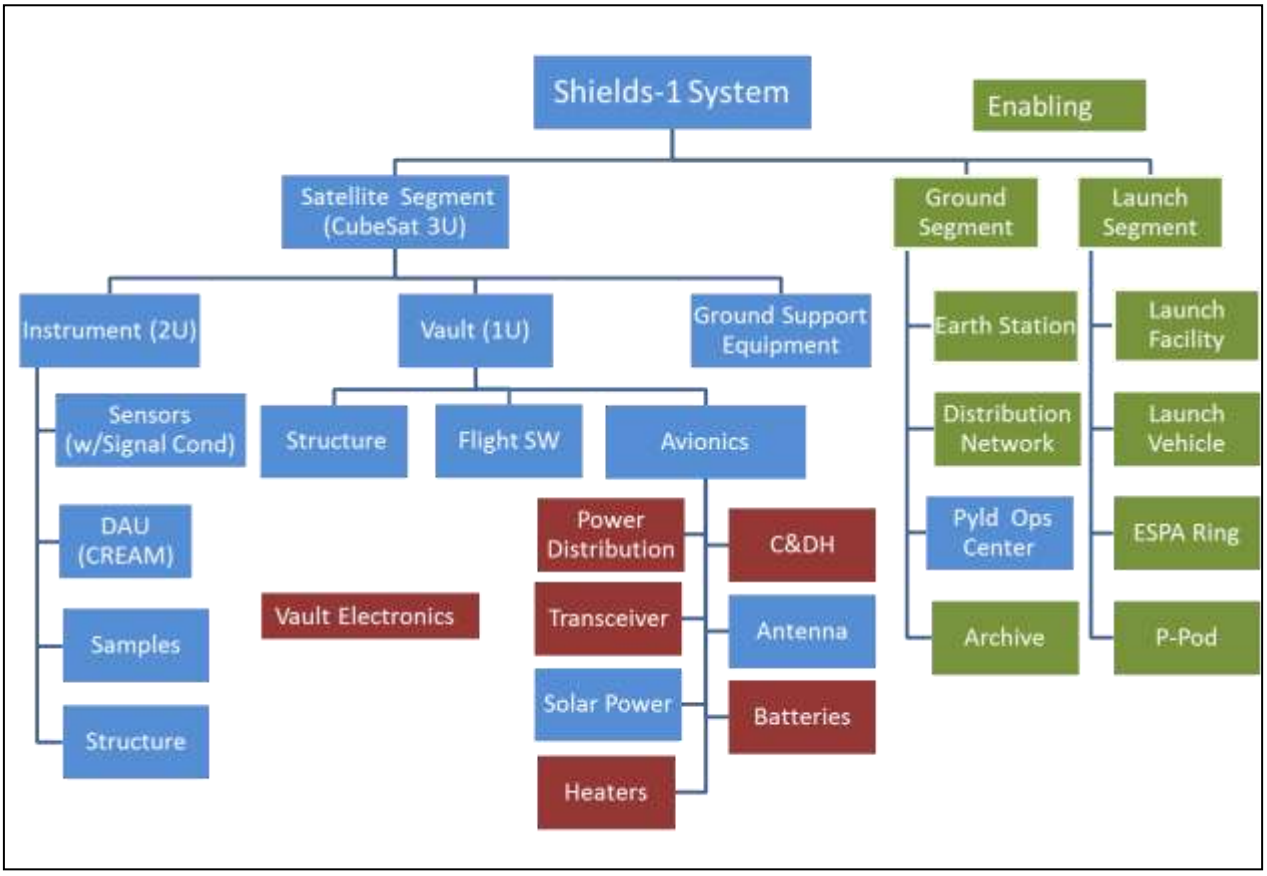

Figure 1-2: Shields-1 System Architecture Diagram, indicating the system of interest and enabling systems. The architecture also identifies the assemblies, see the items in red, which are the subject of this procurement.

2.2 VE Operational Concept

The VE will host Government developed application software and be used to control CubeSat operations, including hardware configuration, command processing, data collection, formatting and downlink. This software will be developed from an application programming interface API delivered with the VE. The VE will also do power management, status and health monitoring, and engineering data acquisition. After delivery to an elliptical orbit, configuration data (table loads) will be uplinked. The VE will recognize, accept and execute ground commands as initiated. The VE will periodically collect data from the instrument and format it for downlink to the ground. Engineering data will also be collected and formatted for downlink. The VE will collect solar power and convert it to internal power for use by the VE and Instrument. The CubeSat will traverse a GTO approximately twice a day. It will not be in view of the selected ground segment antenna every orbit, so it will transmit data and reinitialize the memory when commanded from the ground. The VE will monitor the health and status of the CubeSat and place the VE and Instrument into a safe condition and wait for ground command upon fault detection.

2. VE Interface Context Diagram

An interface context diagram is given in Figure 3-1. The Government will physically integrate an Instrument electronics board with the VE and both will be physically integrated into the Vault, which provides mechanical structure and radiation shielding. A Government provided solar array source will provide primary power to the VE. The VE will provide power to the Instrument and Attitude Determination and Control System (ADCS) magnetorquers. The VE will collect data from the Instrument via digital I/O control over I^2C and RS 422 serial channels. The VE will receive commands via RF uplink and provide data via RF downlink from/to a Government ground station using Government provided, Vault mounted antenna. The Government will develop application software for installation and execution on the VE processor. A VE provided development interface will be used by the Government for satellite integration and test. The VE will be subject to induced laboratory, shipping, launch, and GTO environments within the Vault Structure.

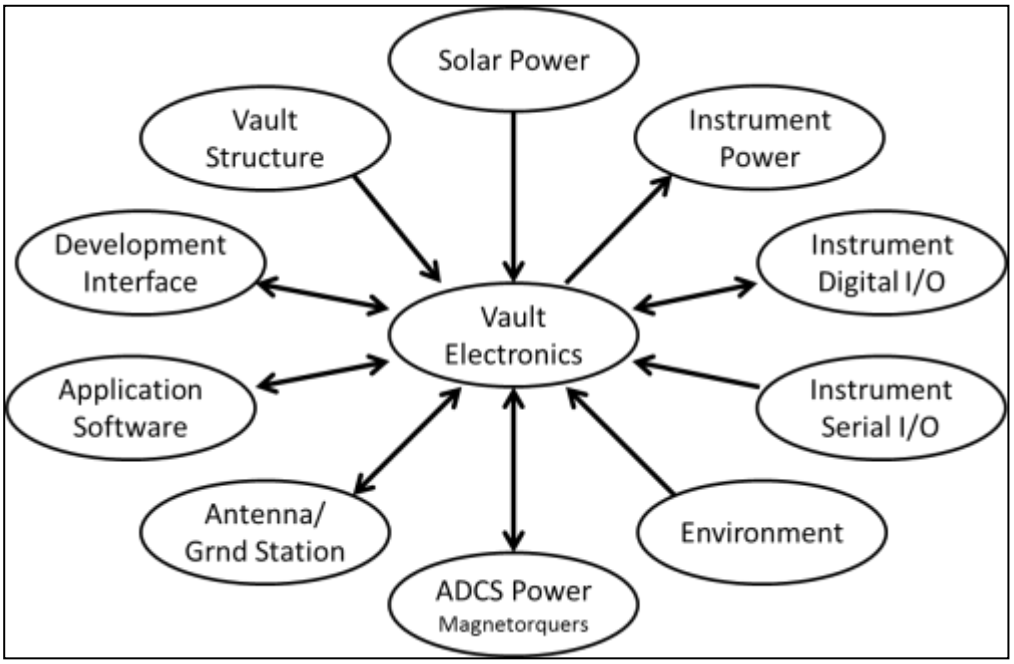

Figure 3-1: VE Context Diagram showing external interfaces to the VE.